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Determinants and consequences of abnormal visual cortex responsiveness in migraine without aura

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Summary

Migraine is a complex multifactorial disease that arises from the interaction between a genetic predisposition and an enabling environment. The greatest amount of sensory information we receive from our surroundings reaches us via the visual system, making vision the most developed sense in humans, and the one that engages the largest areas of the human brain.

Cumulative clinical and experimental evidence has shown that migraine patients are hyper-responsive to visual stimulus, yet the determinants of this phenomenon are poorly understood. Furthermore, though closely associated with migraine, visual hyper-responsiveness is not sufficient, nor necessary, to develop the disorder, suggesting that additional pathophysiological mechanisms must play a role.

The purpose of this thesis was to analyse the environmental, anatomo-functional, metabolic, and neurochemical factors associated with visual responsiveness in migraine patients and the implication of their interaction in the pathogenesis of the disease. We performed therefore a series of neurophysiological and neuroimaging studies that address distinct aspects of cerebral physiology.

The results show that (1) between-subject variability of visual responsiveness in migraine patients can be partially accounted for by environmental influences; (2) visual hyper-responsiveness in migraine is the result of a complex imbalance between mechanisms favouring

enhanced perception and others protecting against sensory overload; and (3) energy supplies available at the cortical level do not match the increased demands generated by enhanced visual responsiveness.

These findings illustrate the complexity of altered visual responsiveness in migraine, increase our understanding of its pathophysiology and set a path for novel lines of research.

Résumé

La migraine est une maladie multifactorielle complexe, qui résulte de l'interaction entre une prédisposition génétique et un environnement facilitant. La majeure partie de l'information venant de notre entourage nous atteint via le système visuel, ce qui fait de la vision la modalité sensorielle la plus développée chez l'Homme et celle qui met en jeu les aires cérébrales les plus étendues.

Un faisceau de données cliniques et expérimentales a montré que les patients migraineux sont hyper-réactifs à la stimulation visuelle, mais les déterminants de ce phénomène restent méconnus. De plus, bien qu'étroitement associée à la migraine, l'hyper-réactivité visuelle n'est ni suffisante, ni nécessaire pour développer la, maladie ce qui suggère l'existence de mécanismes physiopathologiques additionnels.

Dans cette thèse nous avons analysé des facteurs environnementaux, métaboliques, anatomo-fonctionnels, et neurochimiques liés à la réactivité visuelle chez les migraineux, et la possible implication de leur interaction dans la pathogénie de la maladie. Pour ce faire, nous avons réalisé une série d'études neurophysiologiques et de neuroimmagerie qui explorent des aspects distincts de la physiologie du cerveau.

Les résultats montrent que (1) une part de la variabilité inter-individuelle de la réactivité visuelle peut être expliquée par des influences environnementales; (2) l'hyper-réactivité visuelle dans la migraine est le résultat d'un déséquilibre complexe entre les méca-

nismes qui favorisent une perception renforcée, et ceux qui protègent contre une surcharge sensorielle; (3) la réserve métabolique au niveau cortical est insuffisante face à la demande énergétique accrue due à l'hyper-réactivité visuelle.

Ces résultats illustrent la complexité des mécanismes responsables de l'hyperréactivité visuelle dans la migraine, améliorent notre compréhension de la physiopathologie de cette maladie, et ouvrent la voie à des axes de recherche innovants.

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